An IAD type framework for Blockchain enabled smart tourism ecosystem

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ABSTRACT

The concept of smart tourism remains fuzzy when it comes to practice because of the lack of clarity on the roles and responsibilities of stakeholders in addition to complex institutional ecosystem that exist within the tourism industry. Further, trust and safety of the data generated due to the advancement of smart tourism in varied institutional arrangements pose huge challenges. Extant literature proposes that the application of decentralized ledger promises possible solutions to most of these problems due to the inherent features of the Blockchain technology. This suggestion raises two practical questions. First, does the sophisticated additional layer adds complexity to its practical application? Second, will the suggested solutions really lead to a win-win for all the stakeholders involved? In this study, we use Ostrom's action arena to examine the exchanges (information, contractual and monetary) between various stakeholders in a BCT enabled smart tourism of a Blockchain enabled tourism industry to answer these two questions.

1. Introduction

The tourism industry is evolving towards providing technology enabled smart experiences which is a considerable advancement over the traditional practice of using Internet enabled devices only for bookings and maintaining the guest records. With technological advancements, tourism managers receive large amount of consumer data that helps in improved tourist profiling and customized touristic experiences resulting in better market offerings. Appearance of customer-to-customer business models (e.g., Couchsurfing, Airbnb, BlaBla Cars, Freelancer guides etc.) and more intimate data about the tourists pose, a challenge of data storage and security as the data can be manipulated and misused. Recent tourism literature proposes the integration with Blockchain technology to maintain trust and reputation of tourism companies in this decentralized marketplace (Calvaresi, Leis, Dubovitskaya, Schegg, & Schumacher, 2019), where traditional structural assurance agents (Shapiro, 1987) do not fit well. These assurance agents can be banks for transactions, quality assurance agents like TripAdvisor, risk mitigating insurance agents etc. The online marketplace in general has lot more uncertainty compared to traditional brick-and-mortar stores. Further, the intangible nature of tourism products anyway needs more trust in the vendor/seller than for buying tangible goods.

There is an increasing thrust in the tourism industry to adapt and leverage upon the emerging Information and Communication

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Technologies (ICTs) because of the widespread acceptance of its importance in capture and transfer of data when integrated with smart devices. 'Smart tourism' remains an loosely defined concept (Gretzel, Sigala, Xiang, & Koo, 2015) as the literature on smart tourism focuses on many new technologies (e.g., smart sensors, big data, machine learning), new ways of connectivity and exchange of information (e.g., IoT, RFID, and NFC) and psychological mapping in development and delivery of the tourism product but seldom as an interconnection, synchronization and concerted use of different technologies that constitutes smartness' (Höjer & Wangel, 2015). One can understand smart as the use of real-time operational data for ¨analytics,modeling, visualization and integrating the inferences for real time decisions that create better value for the end user (Harrison et al., 2010). In tourism, this smart offering translates to many stakeholders working simultaneously and synchronously for better utilization of resources and a wow experience for the tourists. If we look at examples of how smart tourism development efforts translate into practice, this incoherence of understanding the various aspects of smart tourism becomes evident for e.g., Chinese and South Korean governments funding technological infrastructure projects (Hwang, Park, & Hunter, 2015); Europe focusing more on smart end-user applications to facilitate information transfer and bookings e.g. Barcelona installing interactive bus shelters that provide not just bus information but also touristic information and Amsterdam placing interactive beacons that help tourists with language translations and crowd management based on real-time data (Gretzel et al., 2015).

Despite, these advantages, the smart tourism ecosystem has issues like data privacy, safety, and management. Blockchain technology that is based on Merkel tree algorithm and is a decentralized ledger, offers ready solutions to the above-mentioned issues. In addition, it provides the advantages of increased efficiency, transparency and certainty (Ibid). However, the integration of smart tourism with Blockchain may pose its own issues. The first question that it raises is whether the additional layer of sophisticated technology adds complexity to its practical application? The question that is even more pertinent is whether this integration will indeed lead to a win-win for all the stakeholders involved.

We build upon the published used cases and articles to put the possible interactions that would result from the integration of blockchain technology in tourism in an IAD framework type action arena (Ostrom, 2005, 2011). We discuss the theoretical background in section 2. Doing so helps us examine the relative positions, benefits and possible losses to the involved agents and institutions as IAD has been used to break down and analyze parts of the whole and the resultant interactions. We elaborate on these inter-relationships in section 3. In section 4, we summarize and conclude our discussion. This work examines the use of Blockchain in tourism in practical light. Further, it proposes the use of Ostrom's action arena as a canvas for ranking interactions and resultant well-being.[1]

2. Theoretical background

2.1. Blockchain enabled smart tourism

Smart tourism is defined as "tourism supported by integrated efforts at a destination to collect, aggregate and analyzed [emphasis added] data derived from physical infrastructure, social connections, government/organizational sources and human actors [emphasis added] in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear focus on efficiency, sustainability and experience enrichment" (Gretzel et al., 2015, p. 181).

The two recurrent instruments of smartness in the smart tourism literature are artificial intelligence and rapidly evolving two-sided markets. Two-sided markets (e.g., B2B, sharing economy) involve at least three agents- 'providers' who offer a private resource for sale, rent, or co-usage; 'consumers' who seek to use, rent, or experience the offered products and services and 'platforms' that serves the other two (Lu, Zhao, & Wang, 2010; Hawlitschek, Notheiswn and Teubner, 2018). In tourism, the example of the first agent can be locals who put their rooms or cars for rent or hire at Airbnb, CouchSurfing and BlaBlaCar; the second would be guests, passengers, or renters and the third could be any of the platforms (Hawlitschek, Notheisen, & Teubner, 2018). The platforms or decentralized applications (DApps) play a core function in matching supply and demand, facilitating search, communication, and initiating transactions (Ibid).

Trust is the linchpin of such interactions as renting does not necessarily entrust potential guests who will behave well and not damaging rented property or harm other users of the pooled services. Similarly, customers need to trust on the hosts/owners to provide promised services. The platform also needs to inculcate trust through users, host ratings and reviews as well as via its own reputation (Calvaresi et al., 2019) as the centralized rating agencies like TripAdvisor may no more needed and are losing the importance in these types of market exchanges.

Another technological advancement that is changing the tourism industry is AI. AI has many implications for smart tourism e.g., AI aids accumulation of data and its integration with databases and analytics support from globally used platforms, AI helps in detailed psychographic profiling of the potential tourists that can revolutionize the accuracy with which client's interests can be anticipated (Jessop, 2018) through big data analytics using platforms like Google Analytics. Chatbots & conversational voice formats would enable visitors or agents to discuss preferences and options. AI also enables real time interventions via clients' cell phone options based on their location and preferences. By harnessing data from valuable market segments such as millennials. AI can then, through social media, offer targeted and subtle ways of providing well targeted personalized travel options that relate to an individual's lifestyle (Ibid).

However, the fundamental issue about the use of AI in picking behavioral patterns can sometimes lead to unwarranted

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[1] The use of well-being is being made in a very general sense.

infringement and manipulation of the clients or(and) users in the name of intelligent solutions.

Smart tourism as it grows, calls for the need to bridge digital and physical institutions, artificially intelligent machine enabled environment, public-private consumer collaboration, mutual sharing and an ecosystem enabled by big data (Beverungen, Muller, Matzner, Mendling, & Vom Brocke, 2019; Gretzel et al., 2015; Nam, Dutt, Chathoth, & Khan, 2019). These pre-requisites of smart tourism pose serious challenges like data privacy, data security, data management (Hawlitschek et al., 2018) and trust issues in intermediaries (Gretzel et al., 2015). Blockchain can solve most of these problems and increase efficacy of smart tourism by raising the level of trust in all transactions (monetary and non-monetary) and decreasing the intermediaries in the ambient environment for these new market types (Önder & Treiblmaier, 2018).

As the Blockchain database is composed of interlinked transaction blocks, the system is immutable, i.e., theoretically, once verified and added, a piece of data in this distributed ledger cannot be modified (Nakamoto, 2008). The Blockchain once designed as per needs is self-administered by a peer-to-peer network of miner and non-miner nodes (Ibid). Miner nodes perform the task of verifying transaction(s) made by any of the nodes as indicated by the automated hashing that follows the Merkle tree algorithm (Merkle, 1987), and are rewarded a verification fee (Raymaekers, 2015). All transactions made in a Blockchain network are real-time (Antonopoulos, 2014; Raymaekers, 2015).

Blockchain would facilitate all exchanges of value without the need for an intermediary (De Filippi, 2017). It enables numerous potential cross-industry applications facilitating supply chain, transportation, contracts, and payments, thus helping to reinvent tourism supply chain (Kwok & Koh, 2019).

Blockchain technology would enhance tourist experience by offering personalization of solutions with reduced risk of data misuse, more control to the user in a trusted ecosystem, real-time cross-border remittances, reduced transaction cost of currency exchange, and real-time transactions in even in remote locations where banking facility is not easily available.

Other inherent advantages of Blockchain in smart tourism can be cheaper re-booking of hotel rooms and no double bookings that implies solving double-spend problem due to integration of all travel mediums in a single platform (Varelas, Georgitseas, Nechita, & Sahinidis, 2019).

2.2. Blockchain ecosystem in smart tourism

The Blockchain enabled ecosystem consists of the processes involved in authentication of the customer identity and delivery of the smart tourism product once the payment by the tourist is confirmed. This includes the digital payment channels, supply side agent and authenticator nodes.

i. Digital payment: In a tourism ecosystem, the main issue is of cross-border remittance which can be either done through banks (electronic payments) or B2B settlements. The institutions here, are banks and businesses and the agents in this system are customers, bankers and business owners. The scope of Blockchain in this ecosystem is to facilitate smart tourism by connecting all the agents in a Blockchain network. The transactions then take place through smart contracts and cryptocurrency. Some upcoming examples in Smart tourism domain are Travelflex, Tripago, Roomdao.

ii. Credential management: In a Smart tourism ecosystem, ranking and ratings, verification, and authenticity review become important (Jangirala, Das, & Vasilakos, 2019). The institutions in this system are ranking institutions and reviewers. The advantage of adding Blockchain to this ecosystem is that it helps the raters verify personal data without leakage, maintain privacy and data security. In turn, the raters are automatically rewarded due to the inherent features of Blockchain mechanism. Some mention worthy examples in credential management are LockTrip, Globaltourist, Winding Tree.

iii. Inventory management: Blockchain would allow for a better capacity planning based on information gained from the direct distribution and supplier networks that would act as the different nodes in the Blockchain network. All changes and requests would become public information that would then allow the different nodes to act in the required direction and facilitate planning and distribution.

iv. Reservation and ticketing: Blockchain would also aid in hiring/renting cars, accommodation, booking flights and hotels, and purchasing insurance in a more effective manner because the flow of information is instantaneous. The travelers would then not just passive participants but active players in reselling and re-booking according to changes in their own schedules or effective demand raised by other consumers. Some DApps that perform these functions very effectively are Travala and TravelCoin Foundation.

v. Identity management: One of the biggest issues of smart tourism is the amount of data that is available to be harnessed by not only requisite stakeholders but outsiders. Blockchain prevents this kind of data leakage and its possible misuse by smart contracts that allow for only legitimate sources like passport offices to access personal data and it's usage like the passport offices add visa confirmation. Further, smart luggage and packages could further enhance matching the right baggage to the right customers enabling efficient baggage tracking. This sort of service is of late being provided by Explore that follows two-step authentication.

vi. Loyalty programs: Blockchain through its mechanism enables automated update of information regarding discounts, incentives and rewards thus helping customers make more efficient choices. Further, it also enables the service providers to check the authenticity of the customers, the discounts and rewards due to them, and their speedy availing. For example, Trippki and TravelChain use Blockchain to generate tokens and encashment of reward points.

2.3. Operationalization issues

The tourism industry has evolved to an AI and DApp using domain with a large number of transactions happening digitally. While this smartness has increased efficiency of transactions to a certain extent, the scholars of smart tourism underscore the issues of trust, transaction cost, data management, and data security. With the rapid development and increased usage of Blockchain technology, tourism scholars (Önder & Treiblmaier, 2018) promote its increased usage for B2B partners, platforms ¨and customers alike. We posit and elaborate that integrating Blockchain with smart tourism tools of AI and DApps, resolve these issues. However, the visualizing this ecosystem and how the various agents and institutions contained within it interact with each other. We use the Institutional Analysis and Development framework to identify relevant interactions and understand them.

2.4. Institutional analysis and development (IAD) framework

The fundamental arguments for applying IAD framework in this study are drawn from the institutional theory (Scott, 2004a). It puts into perspective structures (schemas, rules, norms, and routines) in the light of social behavior. Institutional theory focuses on the processes by which structures, including schemes, rules, norms, and routines, become established as authoritative guidelines for social behaviors in any institutional settings. In this domain, the focus is on the design of institutional structures (Meyer & Rowan, 1977), the power of institutional environments on organizations and on shaping beliefs (Meyer, Scott, & Strang, 1987; Mosse, 1997; Powell, 1988) and the evolution of these structures and beliefs over space and time (Scott, 2004b).

The IAD framework is a tool developed by Ostrom (1999, 2005, 2011) to pursue the study of institutions, agents and their interactions. In doing so it is consistent with the objectives of institutional theory without ignoring human agency. Thus, it enables the simultaneous analysis of structural (micro-environmental) factors- regulatory bodies and regulations, economic organizations, technological know-how and social norms; as well as behavior of agents and their choices.

It is a conceptual map that contains the agents and the institutions at play within a space Ostrom calls 'the action arena' (Verma, 2018). The action arena, in turn, is composed of the action situation which is the basic unit of analysis in the IAD framework. "Action situations are the social spaces where individuals interact, exchange goods and services, solve problems, dominate one another, or fight" (Ostrom, 2011, p. 11). Identifying action situation(s) is the primary task of the analyst working with IAD approach. This task is followed by studying the pattern of interactions, their interlinkages and evaluating the resultant outcomes (McGinnis, 2011a).

The IAD framework helps perform two functions effectively. First, it presents the institutions and stakeholders in the same frame (Cole, 2014). Second, it focuses on a small part (action arena) of the larger and much complex picture that the study of full ecosystem
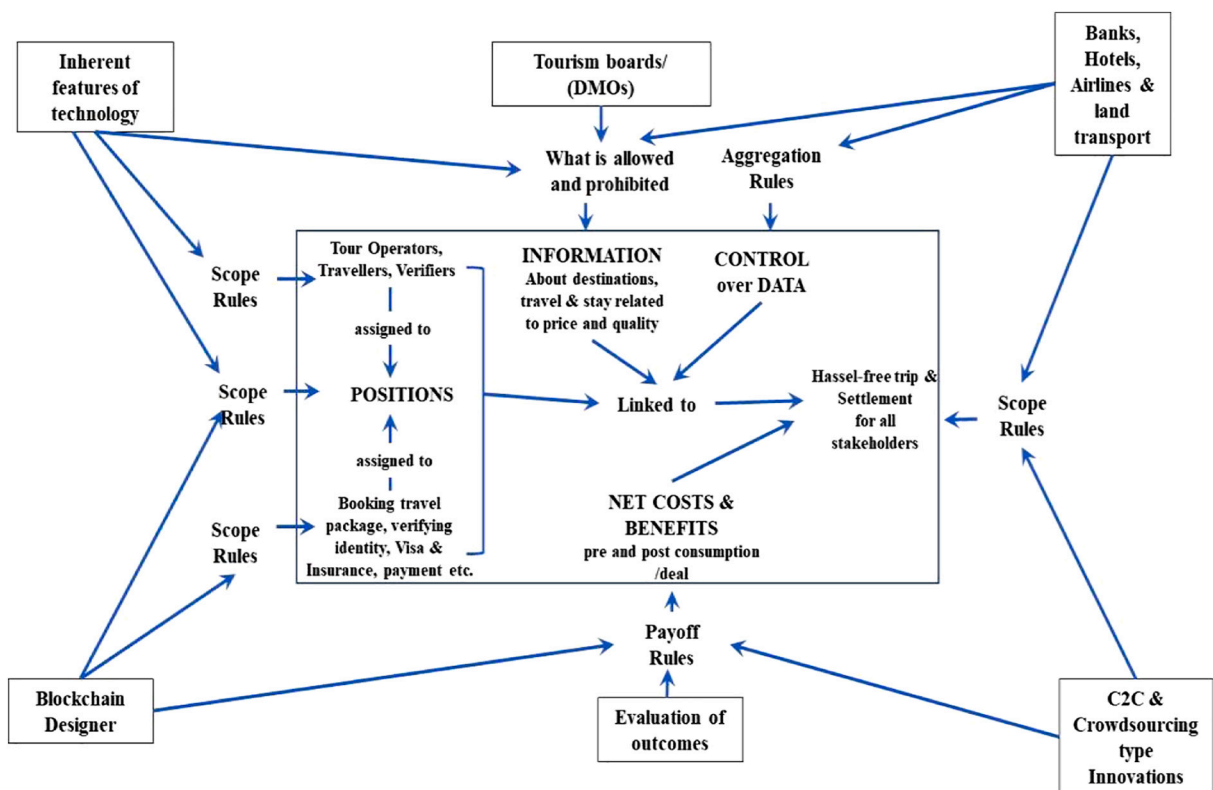

Fig. 1. BCT ecosystem in smart tourism context. Source: Adapted from McGinnis (2011b).

Table 1
BCT ecosystem in smart tourism mapped to IAD.

Participant type (1)		Rules information rules (2)	Payoff		Production (4)	Endowments (5)	Coordination (6)	Power (7)
			Incentives (3a)	Costs (3b)				
Internal	Tour operators, Traveler, Hotels, Airlines & Land Transport, Insurance	Enforce rules/protocol that without approval from 50% of the nodes nothing gets changed on the blockchain	Lower transaction cost Efficient system Reduction in fraud	Cost of verification every short time-period Costs when double spend cannot be verified	The system generates bitcoins based on the PoW	Storage device with required space Internet connection Bitcoin wallet address	Avoiding double spend Avoiding costs of making revisions	Any change in data changes the unique hash that exposes the identity of the cheating node. All transactions linked to the preceding one. Transactions are immutable
	Mining positions can be taken up by Certification agencies, Loyalty Programmes	Linking the chain of blocks or approving transactions Fair competition with other miners Approve legitimate transactions Not approve illegitimate transactions Discourage collusion	Reward from solution in form of bitcoin Fee of validating a transaction	Computational cost Power needed to mine the random key Time involvement for competing with other miners	Random key for each transaction	Application specific integrated circuits Internet Skills to solve the mathematical problem to mine the random key Bitcoin wallet address	Avoiding double spend Avoiding costs of making revisions	Verify solutions of other miners No transactions can be deleted as it is linked to the preceding one
External	Financial intermediaries	Will have to work and disseminate the rules or information laid down by the financial regulatory body	Lower cost of management through a permissioned ledger	Loss of clients Loss of financial transactions and revenue resulting from it	Velocity of money	Currency and digital payments	_	Not accept cryptocurrency
	Government	May go against government rules Government bodies recognize the relative benefits of the blockchain technology and start-off government permissioned public ledgers	Lower cost of management	Identity of the services provider is not evident Loss of services tax Loss of income tax	Order and stability	State resources	Facilitate infrastructure for the adoption of blockchain	Declare blockchain illegal

Source: Authors' own.

with all the agents/stakeholders and institutions represents. Thus, the IAD can help perceive the structure of the Blockchain facilitated smart tourism, how it is embedded within its local and global context and the nature of the human machine interactions in this multi-layered and evolving landscape. It can also catalyze future empirical research by helping focus on the partial analysis of multiple interlinkages arising amongst the presence of varied stakeholders and institutions at different time-periods. Fig. 1 depicts one possible illustration of an IAD based mapping of the Blockchain ecosystem in smart tourism.

3. Action arena of Blockchain ecosystem in smart tourism

Participants: In the IAD framework, the number of individuals, teams or composite actors, their attributes in terms of their age, sex, education, experience (knowledge and skill) is important as they are the decision-making entities. The resources and entitlements of the participants decides their relative positions, and predicts their possible set of actions and strategies. The authorized actions are influenced by the participant in the hope to affect some outcome variable(s). Their choices are revealed in their specific actions. The power or control of the participants in relation to others can be complete, partial or zero. The power of the participants is decided by not only by the stock of the resources they control but also by the level of information at their disposal and their relative position vis-a-vis others in the action arena.

In our proposed ecosystem. The participants are travelers, (aim at getting accommodation, entertainment, restaurants, shopping vistas, transportation and ambience), host community (want good transport to suit their daily needs, urban spaces that they can enjoy without the without the hassle of coping with the tourist traffic), the policy makers (structure free procedures and govern the physical as well as the digital realm of smart contracts and crypto currencies enabled transactions) and the platform designers and developers (create DApps for smart tourism) (Nam et al., 2019).

Potential outcomes: All the intended or unintended outcomes (when all outcome variables are not known, or exact measurements are not possible) can be studied by mapping our proposed ecosystem to the IAD framework. An outcome is a combination of material and physical payoffs called value. The range of the values of the outcome variables decides the extent of opportunity to the participants in the action arena. The final outcomes are judged on the criteria of efficiency, economies of scale, equity in distributional outcomes and processes, legitimacy of the participants in decision making and participation, accountability, resilience, robustness, or sustainability of the system.

In this ecosystem, the potential outcomes can be transparent transactions, lower transaction costs, efficient choice making, the possibility of breakdown due to corruption in the Blockchain system (Marwala & Xing, 2018), and adverse policies disabling Blockchain applications in certain countries.

Action-outcomes linkages: The link between control variable and the state variable is established through these linkages. The reasons for state variable- to come into being or to disappear are also studied in the IAD framework. In the Blockchain enabled smart tourism action situation, the ecosystem would appear due to better Internet infrastructure, improved knowledge and technology and can disappear due to corruption in the network and(or) adverse policies.

Risk and uncertainty: When every available action is linked directly with one and only one outcome then, that situation is categorized as certain. When one-to-many relationships between actions and outcomes with known objective probabilities are possible, the situation is categorized as risky. When one-to-many relationships between actions and outcomes with unknown objective probabilities are there, then, the situation is categorized as uncertain.

In the Blockchain enabled smart tourism action situation, the ecosystem has lower risk and uncertainty if it is facilitated by better Internet infrastructure, improved knowledge and technology that accompany modernization (Nam et al., 2019) and can increase with the presence of more dishonest nodes in the network and(or) unclear policies due to the inability to define the Blockchain phenomenon and find its fit in the existing system.

Rules: Rules decide the choices of the participants. They specify the payoffs both positive and negative, nature and extent of possible actions, and actions themselves. Position rules specify a set of positions. They define the endowments, set of the participants relating to the resources, opportunities, preferences, and responsibilities. These rules are of various types-boundary rules, authority rules, aggregation rules, scope rules, information rules and payoff rules (Ostrom, 2011). The boundary rules are concerned with the entry and exit of the participants from their respective positions. Authority rules state the set of strategies assigned to each position. Aggregation rules are about the transformation of actions to outcomes. Scope rules identify the set of outcomes in an action situation. Information rules specify the available information endowed to each position. Payoff rules specify rules about the negative and positive payoffs accruing to each participant at each position depending upon the strategies played by them.

Choices: Choices can be broadly of three types- operational choices that are made by participants sanctioned to take certain actions, collective choices that help construction of institutions and policy decisions, constitutional choices that define collective choice procedures. The constitutional, collective, or operational choice processes are legitimate within a certain context which may be determined by local culture; law of the land, etc. In the BCT enabled Smart tourism, the operational choices are made by service providers, customers and platforms, collective choice is made by the tourism boards and constitutional choices are made by national and international policy making bodies regarding the legitimacy of Blockchain enabled transactions and contracts.

Level-shifting: When cultural factors change over time there is a shift within previously established rules to making decisions about the rules structuring future actions. Another way in which there is a level shift that may ask rules to be changed is through the learning that occurs. As BCT is an emerging technology (Swan, 2015) that is more often misunderstood (Marwala & Xing, 2018; Nam et al., 2019), there is scope for future learning, reclassification and better usage of BCT. This would improve its ability to facilitate smart tourism as well i.e., level shifts in future.

Table 1 elucidates these different rules for blockchain enabled smart tourism action situation. While, BCT's integration with

Table 2
Actor types and key action situations.

Actor Types (1)	Primary Motivation (2)	Service (3)	Payment (4)	Monitoring/Sanctioning (5)	Rule Making (6)	Coordination (7)	Dispute Resolution (8)
Traveler	* Ease in Reselling and cancellation * Transparency * Best value and Lower price * Validation fee	* Third party validation	* Instantaneous payment using Cryptocurrency	* Validation on the blockchain platform		* Hotels * Supply chain * Other service providers like cab services	
Hotels	* Profit due to disintermediation * Easy maintenance of guest database (−) Loss in cancellation fee	* Transparency that improves reputation	* Instantaneous fund receipt and payment			* Travelers * Supply chain * Other service providers like cab services	
Banks and other Financial Institutions/ Insurance agencies	* Lower data storage cost * (−) Loss of business due to disintermediation	* Quicker service due to quick validation		* Information dissemination and execution of Rules about Cryptocurrency transactions and trade		Easy Coordination with * Travelers * Hotels * Regulatory Bodies	* Banking related disputes
Tour operators/ Certification agencies	* Validated information * (−) Could lose validity due to traveler led validation and information dissemination	* Improvement in service rendered	* Higher payment for quality service * Instantaneous fund receipt				
Airlines/land transport	* Reduction on transaction costs * (−) Loss in cancellation fee	* Ease in luggage tracking					
Regulatory bodies	* (−) Anonymity leading to tax evasion, using BCT for illegal activities etc. * (−) Disruption and financial issues affecting a large number of people in case of breakdown * (−) Additional expense to maintain new dispute resolution committees or tribunals			* Rule making about the Information dissemination and execution of ** Cryptocurrency transactions and trade ** Smart contracts * Vigilance and monitoring institutions to detect fraud or prevent breakdown	* Terms of use of BCT * Rules regarding dispute resolution * Rules to take care of breakdown situations		* Formal inquiry and further proceedings like litigation, policy making etc. * Creation of dispute resolution committees and tribunals

Source: Authors' own.

tourism would benefit several agents, not all in the different action situations would benefit from it immediately. Certain actors and institutions will have to adjust their rules for certain action situations to create benefits for all the involved stakeholders as we see in Table 1 in case of the regulatory bodies or governments. Government bodies would be ablet to create such a situation once they would recognize the relative benefits of the blockchain technology and start-off government permissioned public ledgers that would take care of the issues related to anonymity and lack of central control which in some instances are beneficial but in times of breakdown would cause issues related to responsibility and coordination.

These inter-relationships amongst the various stakeholders are further broken down in Table 2 into their primary motivations from the BCT integration with tourism, possible service they could provide as a result, payment etc. It is evident from Table 2 that most actor types would be motivated due to ease, transparency, increased efficiency, better value and lower prices offered by this integration. However, it is also evident that many actors could also see some primary motivation to desist from this integration. Airlines and land transport services could lose out on the cancellation fee if it becomes easy for the traveler to resell the ticket to a third party in the event of a cancellation. Tour operators and rating agencies could lose due to traveler led validation and information dissemination. Regulatory bodies could see more disturbance due to the use of BCT to evade taxes and engage in illegal operations. They would also see an increased need for rule-making to prevent disruption and financial issues affecting a large number of people in case of breakdown. They would also incur additional expenses to maintain new dispute resolution committees or tribunals.

Thus, we see that while the sophisticated additional layer of BCT adds additional issues to its practical application in the tourism ecosystem, we also see that some actors/institutions fade out as they eventually lose their relevance and new institutions or agents take their place. This answers our first research question. This finding resonates with the work done by institutional theorists. A standard outcome of a transition is to see existing institutions give way to new ones. In the past this has happened when the economic system changed from traditional to modern, giving way to capitalist institutions that were the harbinger of the market economy (Granovetter, 1985; Sachs, 1999) replacing social institutions with economic ones. The next wave of changes would further reduce the need to maintain trust in an institution (that is a complex system of various actors interpreting and executing the rules that make up the institution) and would replace them with a decentralized, distributed and immutable ledger.

While, answering our first question, we also observe that all actors may not end up getting better-off. While, airlines and land transport will gain by reduction in transaction costs, they lose in cancellation fee. But, at the same time they will be able to manage luggage tracking. The hotels gain through increase in profit due to disintermediation and easy maintenance of guest database but again lose in cancellation fee. Yet, they gain by reducing their inventory through an improvement in supply chain management. While, Tour operators/ Certification agencies gain by giving Validated information to their customer, they could lose validity due to traveler led validation and information dissemination. Similarly, Banks and other Financial Institutions/ Insurance agencies would gain by Lower data storage cost but may see a loss of business due to disintermediation. So, no. Immediately, the suggested transition to the Tourism ecosystem after an integration with BCT will not lead to a win-win for all the involved stakeholders. However, as the answer we get by analyzing the changes in the tourism ecosystem post an integration with BCT, for our first research question points out, eventually, stakeholders will adapt to the changes in the new ecosystem will learn new ways of existing. Now, the relevant question is why then would such a change occur is because it does provide us answers to bigger issues that touch the lives of a much larger set of stakeholders than the ones who seem to the relative losers in the short run.

4. Contributions and future research

Smart technologies are rapidly transforming the field of tourism (Gretzel et al., 2015). They not only present many opportunities but also challenges. With ever increasing reliance of countries on tourism sector's contributing to GDP as well as an urgent need to upscale tourist experience, wellbeing and stakeholder value, smart tourism seems to be a way forward. A major concern in felicity of the stakeholders is data privacy and security in the context of smart tourism (Gretzel et al., 2015).

Recent scholarship in tourism (Kwok & Koh, 2019; Nam et al., 2019; Önder & Treiblmaier, 2018; Varelas et al., 2019) suggests that Blockchain technology will lead to reduced uncertainty in tourism related transactions, encourage new market types and increase disintermediation in the tourism industry. Our paper helps us to visualize the integration between BTC and tourism.

We use an IAD based framework to piece together parts of the whole ecosystem by studying the interactions between various organizations, key agents and institutions of the tourism industry in the probable situation of an integration with BCT. In attempting to do this aggregation, we piece the relative gains, change in positions and resultant strategies and in some cases, fading of some institutions that have been important within the tourism ecosystem to new ones (like dispute resolution tribunals for smart contracts and cryptocurrencies).

We find that while, the integration of Blockchain to smart technology enabled tourism increases the complexity due to the sophisticated technology on one hand, we also expect reduction in complexity due to expected disintermediation. Further, we find that this huge technological shift due to the integration of BCT with tourism is also overall beneficial to a larger set of stakeholders with a few actors/institutions losing bowing out of the scene due to loss of relative power to influence the ecosystem. In doing so, it examines the use of Blockchain in tourism in practical light as well as proposes the use of Ostrom's action arena as a canvas for grading interactions and resultant well-being of stakeholders.

This work can be extended by focusing on the evolution of the tourism industry and its progress towards smartness by analyzing different types of action situations resulting at different points in time due to the differences in the agents, resources and rules of the game which would further clarify our understanding of the relative benefits of BCT's integration with the tourism industry. This identification of various stakeholders through IAD based framework would catalyze future empirical research by helping focus on the partial analysis of multiple interlinkages arising amongst the presence of varied stakeholders and institutions at different time-periods,

the need for multiple blockchains to maintain control or a total shift in the balance of power from authorities to all the members or nodes of the blockchain in tourism sector.

CRediT authorship contribution statement

Janardan Krishna Yadav: Conceptualization, Writing - original draft, Writing - review & editing. **Deepika Chandra Verma:** Data curation, Writing - review & editing, Writing - original draft. **Srinivas Jangirala:** Conceptualization, Writing - review & editing. **Shashi Kant Srivastava:** Conceptualization, Writing - review & editing.

Appendix A. Appendix

Abbreviation	Expansion
AI	Artificial Intelligence
B2B	Business-to-business
BCT	Blockchain Technology
DApps	Decentralized Applications
IAD	Institutional analysis and development
ICT	Information & Communications Technology
IoT	Internet of Things
NFC	Near Field Communication
RFID	Radio-Frequency Identification
PoW	Proof of Work

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